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TREATMENT OF SLUDGE FROM SEWERAGE AND BURNT ASHES

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54 Treatment of sludge from sewerage and burnt ashes

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SIMPLE EXPLANATION OF THE ILLUSTRATION:

This illustration shows one example of the invention of this machine.

The details of the invention follow:

If we allow the wastes from sewerage and industry to pile up without treating them, then it will soon accumulate to an enormous amount, which will cost a great deal of money to handle. Because of this, in recent years, sewerage sludge has been dehydrated and burned to a solid state to reduce the volume, and then the remaining ashes have been treated. But this still leaves a problem after the sewerage sludge has been treated.

In order to filter-dehydrate such sewerage sludge by a vacuum filter, ferric chloride or ferrous sulfate and a precipitate such as calcium hydroxide are added to formulize flocks. It is then filtered to remove the solids which will be burned with heavy oil. But after the solids have been burned, there is left the problem of treating the ashes and the exhaust gas from the burning,

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which contains harmful elements and is bad smelling. This problem has not yet been solved.

Thus this invention will attempt to solve this problem of how to treat the leftover ash and exhaust gas. Calcium hydroxide and ferrous sulfate, etc., will be added to the sewerage as flocking formula in order to filter-dehydrate the matter. The result will be a solid, which will be burned, leaving an ash behind which will then be treated. First the sludge will be burned at 800°C or higher temperature, then separated into ashes which contain CaO and Fe_2O_3. The ashes which contain CaO will be collected and used as flocking formula. The ashes which contain the iron will be added to water, and a reaction will result with the hydrochloride and sulfur anhydride which are taken from the exhaust gas.

Ferric chloride acid (see formulas on page 5) will be formed, and the solution will be divided into solids and liquids. The acid solution liquid only will be collected, which contains the element of iron, and will be used as a flocking formula chemical and will be poured into the sludge and raw liquid which is to be filtered. This is the characteristic of this treating method.

Next, we will use one example of this invention's use and explain it in detail. This is related to the treatment of city sewerage wastes (sludge). As is shown in the illustration, the sewerage will go into the sludge cleaning tank (#1) and be cleaned. It will then be placed in the mixing tank (#2). In the mixing tank, flocking formulas such as $FeCl_3$ and $Ca(OH)_2$ are mixed from chemical tank #3 and #4. This raw filter liquid is sent to the vacuum filter (#5), separated into solid and liquid, the liquid being taken to tank #6 and the solid being filter dehydrated. It becomes a cake which contains 70% moisture. The analysis of the cake is:

Ignition loss	34.8%
SiO_2	13.6%
Fe_2O_3	16.5%
Al_2O_3	7.2%
CaO	23.4%
MgO	2.7%
Misc.	1.8%

The above is general, but the calcium chlorine in the cake is $Ca(OH)_2$, $CaSiO_3$, and $CaCl_2$. The iron is present in the form of $Fe(OH)_3$, $FeCl_3$, and the aluminum is $Al_2(OH)_3$, $Al_2(SO_4)_3$, and $Al_2O_3Si_4$. There is very little organic matter mixed.

These cakes will then be burned in the incinerator (#10). In order to treat the ashes well by this invention, the incineration temperature cannot be less than 800° C. This is necessary in order to separate the calcium compound, thus it is advisable to do this process at temperatures of greater than 800° C. However, the cake still contains 70% moisture, so before it can be incinerated it will be sent by conveyance (#7) to the hopper (#8), the cake dumper (#9), and to the drying room (#10a), and after it has been well dried, on to the incinerator (#10b), where heavy oil will be burned, and 10c burner, where at a temperature of 800-1000° C, the cake will be completely incinerated.

Reactions in the cake as a result of incineration will be:

$$Ca(OH)_2 \text{ — } CaO + H_2O$$

$$CaCl_2 + H_2O \text{ — } CaO + 2HCl$$

$$CaCO_4 \text{ — } CaO + SO_3$$

$$CaSiO_3 \text{ — } C_2O + SiO_2$$

$$2Fe(OH)_3 \text{ — } Fe_2O_3 + 3H_2O$$

$$2FeCl_3 + 3H_2O \text{ — } Fe_2O_3 + 6HCl$$

$$2Al(CH)_2 \text{ — } Al_2O_3 + 3H_2O$$

The above reactions progress, so in the exhaust gas CO_2, HCl, etc., which are an outcome of the incineration of the sludge, and CO_2 and SO_2, etc., which are a result of the burning of the heavy oil, are released and mixed with acidity. In the ash from the burned sludge there will be CaO, Fe_2O_3, Al_2O_3 and SiO_2 left, but the ratios of elements which are in the burned ashes and the specific gravity and outward specific gravity of the iron elements and calcium elements are:

		Specific gravity	Outward specific gravity
SiO_2	20.7%		
Fe_3O_3	25.4%	5.24	2.0-2.2
Al_2O_3	11.1%		
CaO	36.0%	3.40	1.2
MgO	4.1%		
Misc.	2.2%		

In particular, the difference in the specific gravity of the calcium elements and iron elements is great, and the size of the particles also differ greatly. Of the iron elements, more than 60% are 15-25 micron, and of the calcium elements, more than 60% are 5-18 micron. Therefore it is easy to differentiate the classes. Thus, in the illustration, #11 is constructed as a cyclone, #11a and #11b. This is the differentiator, and in this invention, the ash which is discharged from the incinerator #10b will be sent to the differentiator #11 with the exhaust gas. First the ash containing the iron elements will be separated and collected at #11a. Then the rest of the ash will be sent to #11b, where the ash which contains the calcium will be collected. In actual operation, the exhaust gas will be sent back to the dryer room #10a, and then it will be supplied to the reaction tower (#13). After going through the cyclone differentiator, the ratio of the elements in the burned ash will be as follows:

a. mainly calcium elements:

CaO	83.3%
Fe_2O_3	6.1%
Al_2O_3	4.1%
SiO_2	4.2%
MgO	2.0%
Misc.	0.3%

b. mainly iron elements:

Fe_2O_3	86.3%
CaO	5.3%
SiO_2	4.8%
MgO	2.1%
Al_2O_3	1.1%
Misc.	0.4%

The ash which contains calcium is separated and collected, to be used as a flocking formula and to control P.H. by putting it into the raw filtering liquid in the mixing tank #2. The ash which contains the iron elements will be put into agitation tank #12 where water will be added, and agitated to slag of 30-40%. It will then be sent to the reaction tower #13, then through the dryer #10a, and will be reacted with the incinerator exhaust gas. In this process, in the reaction tower #13, the incinerator exhaust gas and the slag's iron elements react as:

$$Fe_2O_3 + 6HCl \text{ — } 2FeCl_3 + 3H_2O$$

$$2Fe_2O_3 + 3SO_2 \text{ — } Fe_2(SO_4)_3$$

Thus, the slag will be put into the separation tank #14 and will be separated into liquid and solid. Only the acid liquid, which resolves iron elements, will

be collected, but the liquid from the separation will go through agitation tank #12 and again to reaction tower #13. After the density of iron and chlorid have been increased, it will be put into mixing tank #2 and be re-used as a precipitate chemical. The solid which is separated in the separation tank #14 will be collected and discharged.

As the above explains, the sludge's burned ash will be classified into those which contain iron and those which contain calcium and will be collected for reuse as precipitates. The recovery of iron and calcium is over 70%, and only 20-30% of the supply is needed to continue this filtering process smoothly, according to his invention.

Also, according to this invention, from the classified ash which contains mainly iron, the acid liquid which resolves the iron will be collected, while the solid will be discharged. Thus, the solids which are not used as precipitate chemicals will not be piled on the process of filter hydration. For the process of iron recovery, the acid gas which is in the exhaust gas of the burning sludge is useful for the purpose of reuse of ferric chloride, and it is successful in eliminating harmful elements in the exhaust.

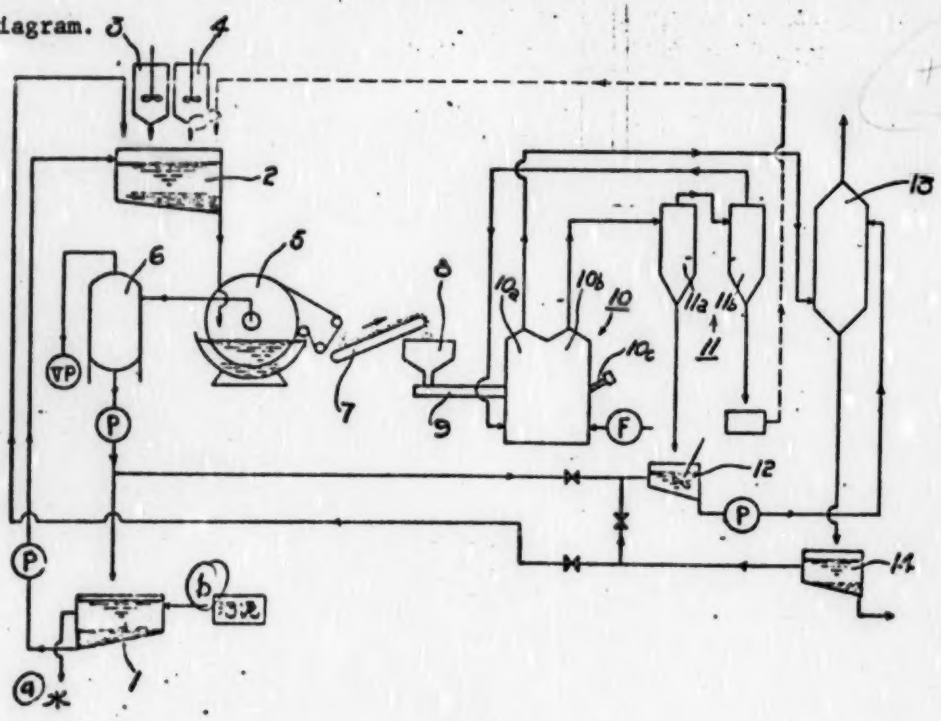
The treatment of the burned ash of the sewerage sludge is done very rationally, and since the filter dehydration and burning of the sludge can be done in one process, it is both economical and hygenic, and is smooth running.

AREAS FOR WHICH A PATENT IS REQUESTED:

1. The sludge will be burned at more than 800°C, then the ash will be classified by cyclone into the ash which contains calcium and the ash which contains iron. That which contains calcium will be recovered and then used as flocking formula. It will be placed into the filtering raw liquid sludge. This is the characteristic of the treatment of burned ashes of sewerage sludge.

2. The sludge will be burned at more than 800°C, then the ash will be classified by cyclone into the elements which contain calcium and iron. The ash which contains calcium will be recovered and used as a flocking formula. It will be put into the raw filtering liquid sludge. To the ash which contains iron, water will be added, and it will be reacted with hydrochloride and sulfurous anhydride which are in the exhaust from the furnace. This will form ferric chloric acid which will then be separated into solid and liquid. The liquid which resolves the elements of iron will be reserved and used as a flocking formula in the sludge raw material. This is the characteristic of treating burned ash from the sewerage sludge.

See diagram.



a. water

b. sludge